UNIVERSITY OF JOHANNESBURG

PROGRAM	:	BET *CIVIL ENGINEERING*
SUBJECT	:	**STRUCTURAL ANALYSIS 2B**
CODE	:	**STRCIB2**
DATE	:	SUMMER SSA EXAMINATION 07 JANUARY 2020
DURATION	:	(X-PAPER) 12:30 - 15:30
WEIGHT	:	40 : 60
TOTAL MARKS	:	100

EXAMINER	:	MR F THAIMO
MODERATOR	:	DR I MUSONDA
NUMBER OF PAGES	:	4 PAGES

INSTRUCTIONS	:	SCIENTIFIC POCKET CALCULATOR MAY BE USED
REQUIREMENTS	:	2 SHEETS OF A4 GRAPH PAPER PER CANDIDATE.

INSTRUCTIONS TO CANDIDATES:

PLEASE ANSWER ALL THE QUESTIONS.

QUESTION 1

The frame **ABC** shown as Figure 1 below is pinned at both supports A and C. The frame is subjected to loading as shown on the Figure

1.1 Using laws of static equilibrium, determine the reactions at the supports A and C and sketch a free body diagram for the frame, showing the loading and support reactions. **(14)**

1.2 Draw Shear Force, Bending Moment and Axial Force Diagrams. **(11)**

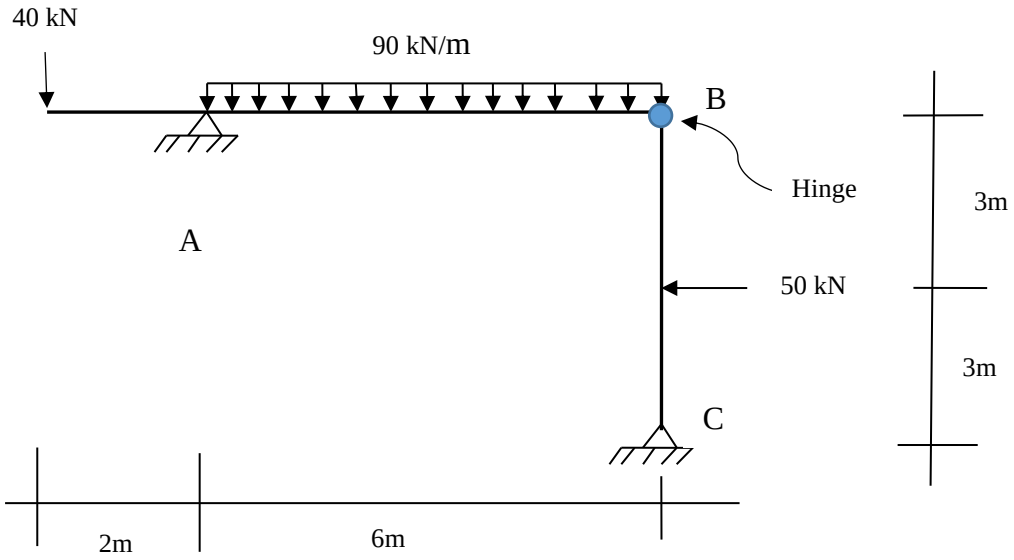

FIGURE 1

[25]

QUESTION 2

Figure 2a shows a cantilever beam subjected to two point loads one of 5kN applied at 2m from the free end A and the other of 10 kN acting at 2 m from the fixed support B, as shown on the Figure. The flexural rigidity (EI) of the beam section is $80x10^3$ kNm^2.

a) Under the given loading, calculate the slope and deflection at the free end A. **Use MOMENT AREA method**.
b) If a uniformly distributed load (UDL) is to be applied over the entire length of the beam as shown in Figure 2b, instead of the point loads, what should be the magnitude of the UDL to produce the same deflection as obtained under the point loads in 2 a).
c) P**lease note**: show all steps to arrive at your answers, including diagrams.

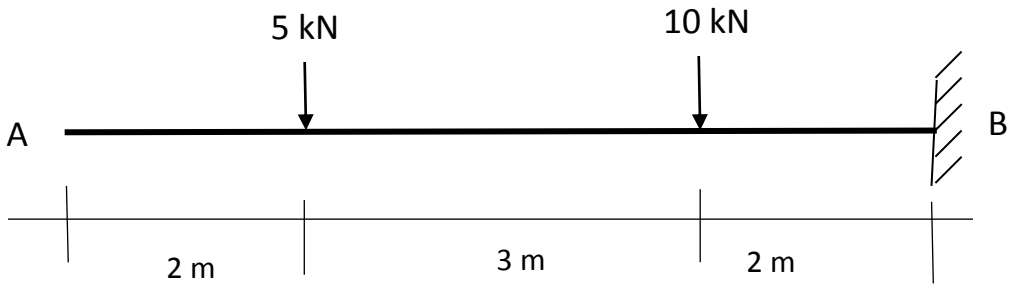

FIGURE 2a

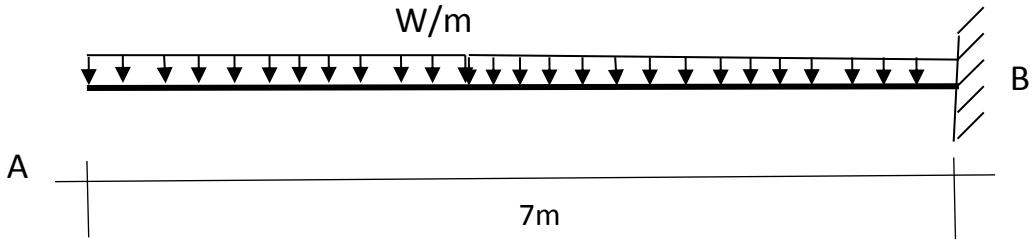

FIGURE 2b

[20]

QUESTION 3

The continuous beam **ABCD** shown as Figure 3 below, is fixed at support A and supported by pin rollers at B, C and D. The beam is subjected to loading as shown on the Figure. The flexural rigidity EI for the beam is constant.

Using **SLOPE DEFLECTION** method, draw Shear Force and Bending Moment Diagrams for the beam on the graph paper provided.

Slope deflection equations are as follows:

$$M_{AB} = \frac{2EI}{l}\left[2\theta A + \theta B - \frac{3(\Delta B - \Delta A)}{l}\right]$$

$$M_{BA} = \frac{2EI}{l}\left[\theta A + 2\theta B - \frac{3(\Delta B - \Delta A)}{l}\right]$$

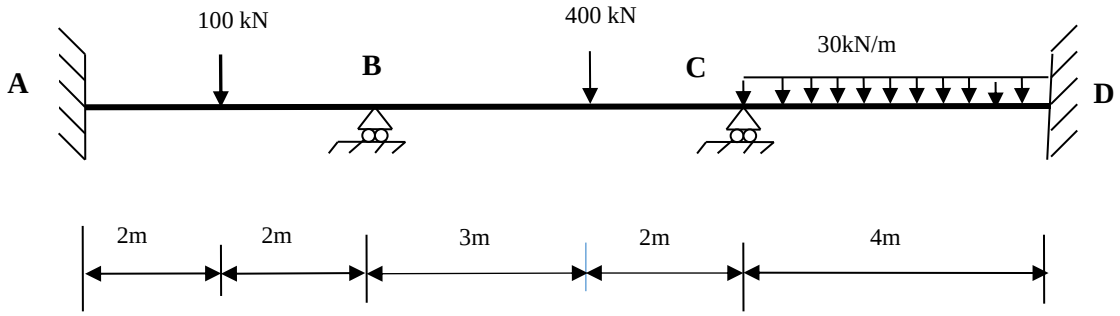

FIGURE 3

[30]

QUESTION 4

A structural steel member of rectangular cross section, 4 m long, is used as a compression member (strut). The cross section of the member is 75x150 mm deep. The end conditions are such that the strut is fixed at both ends for bending about the weaker axis i.e. y-y axis, and pinned at both ends for bending about the stronger axis i.e. x-x axis. The properties of the section are as follow:

σ_y = 300 MPa
E = 200 GPa

a) Calculate the buckling stress and the buckling according to Euler theory.
b) What is the buckling stress and the load to produce the stress if Rankine and Gordon equation is used?

[25]

Total: 100 marks =100%